

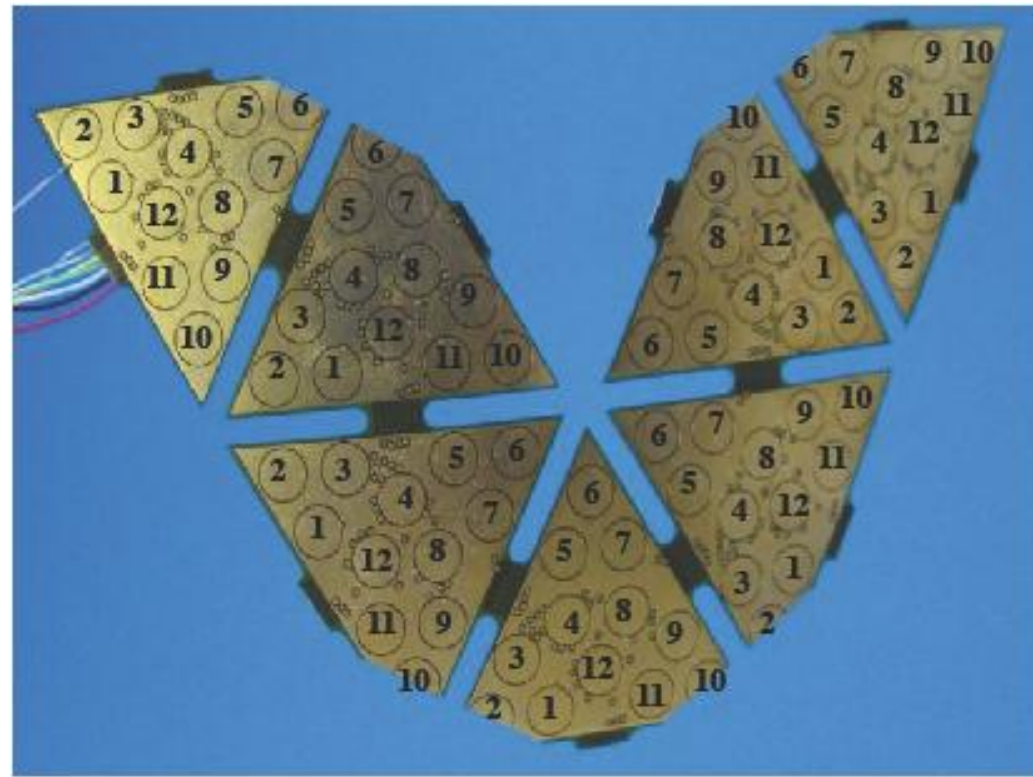
# iCub Skin Tutorial

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- Skin data frequency: 50 Hz
- The skin is divided in patches (hand, forearm lower, forearm upper, ...)
- Each patch:
  - has its own microcontroller
  - can read at most 192 values (16 triangles)
  - is organized in triangular modules

# Basic Information

- Each triangle contains 12 tactile elements, called taxels



# All you need to know

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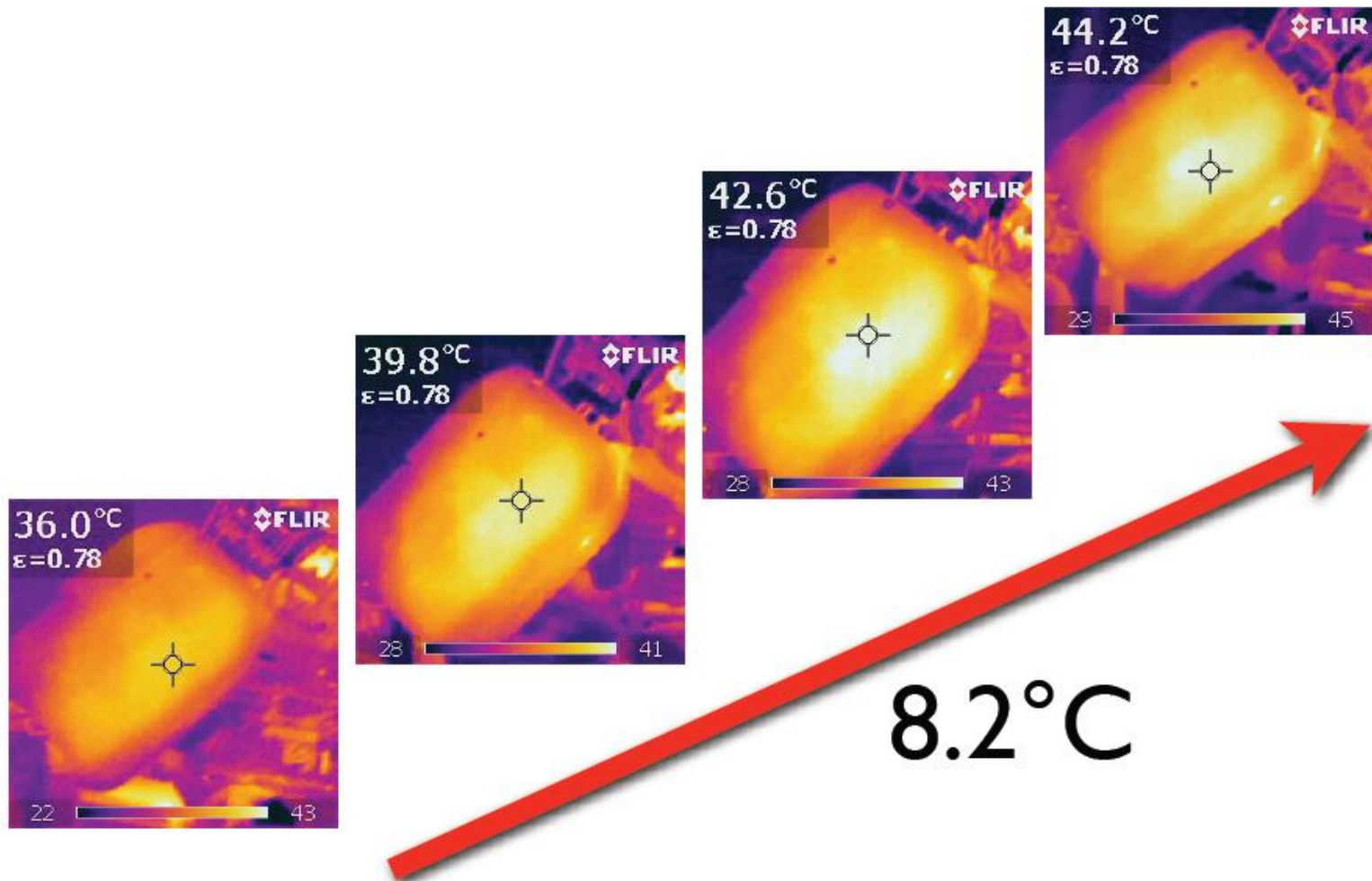
- SkinDriftCompensation
- SkinDriftCompensationGui
- iCubSkinGui
- (iCubInterface)

# SkinDriftCompensation

- Software module located in:  
\$ICUB\_ROOT/main/src/modules
- Compensates for the thermal drift of the skin
- Can handle **many input ports** at the same time
- Optionally applies a **low pass filter** to the data
- Computes the **touch threshold** for each taxel
- Online documentation:  
[http://eris.liralab.it/iCub/main/dox/html/group\\_\\_icub\\_\\_skinDriftCompensation.html](http://eris.liralab.it/iCub/main/dox/html/group__icub__skinDriftCompensation.html)

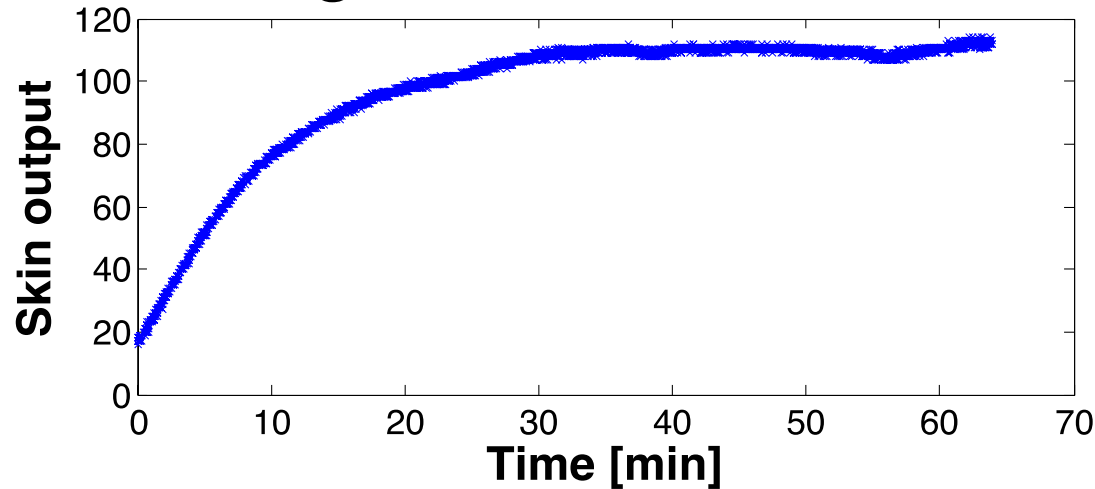
# Thermal Drift

17:00      17:15      17:30      17:45

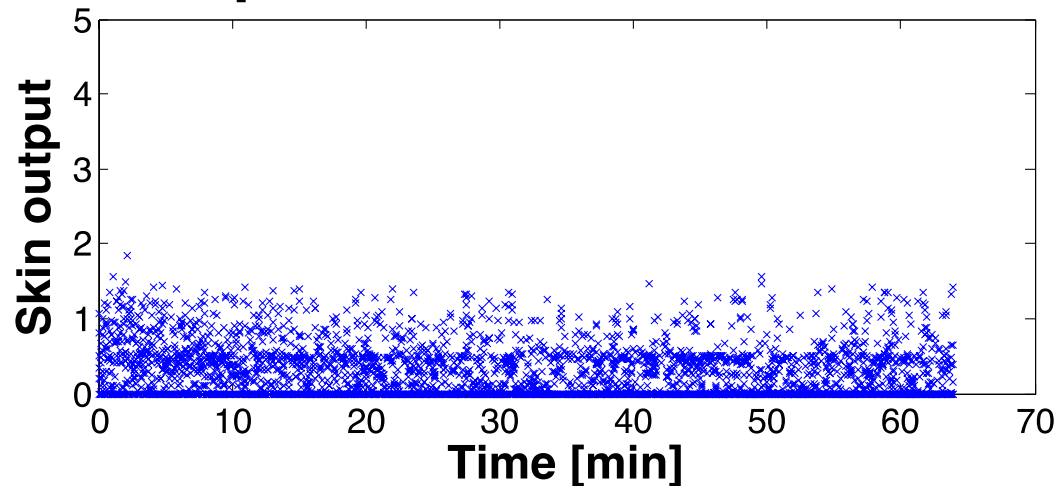


# SkinDriftCompensation

## Original values – Taxel66

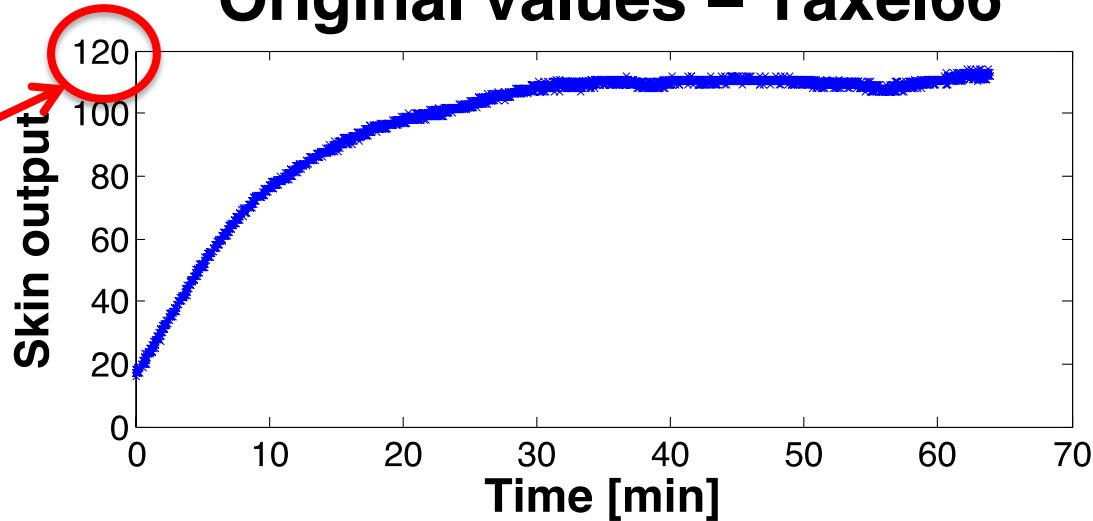


## Compensated values – Taxel66



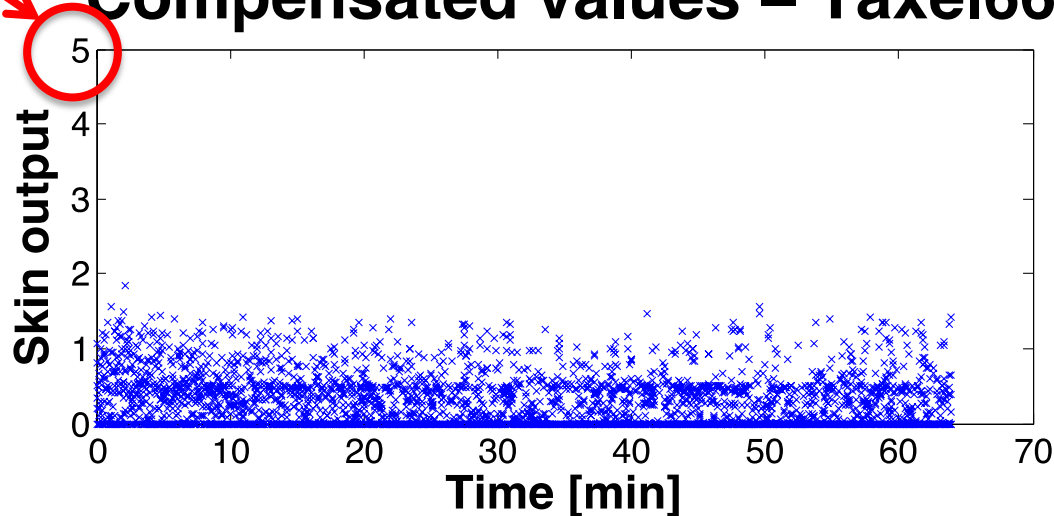
# SkinDriftCompensation

## Original values – Taxel66



DIFFERENT  
SCALES !

## Compensated values – Taxel66





```
driftCompLeft.ini CompensationThread.h Compensator.cpp Compensator.h SkinDriftCor

inputPorts (    /icub/skin/left_hand                \
                /icub/skin/left_forearm_lower         \
                /icub/skin/left_arm_upper_bottom      \
                /icub/skin/left_arm_upper_external   \
                /icub/skin/left_arm_upper_internal   \
                /icub/skin/left_arm_lower            \
                /icub/skin/left_forearm_upper        )

outputPorts (   /icub/skin/left_hand_comp             \
                /icub/skin/left_forearm_lower_comp    \
                /icub/skin/left_arm_upper_bottom_comp \
                /icub/skin/left_arm_upper_external_comp \
                /icub/skin/left_arm_upper_internal_comp \
                /icub/skin/left_arm_lower_comp        \
                /icub/skin/left_forearm_upper_comp    )

period          20
minBaseline      3
zeroUpRawData    false
robot           icub
name            leftSkinDriftComp
smoothFilter
smoothFactor     0.5
```

# Raw Skin Output

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- Each skin taxel output is a byte (0, 255)
- If there is no pressure the output should be 235 (i.e. the baseline)
- When a pressure is applied the output **decreases**
- In the previous versions of the firmware the baseline value was 244

# Compensated Skin Output

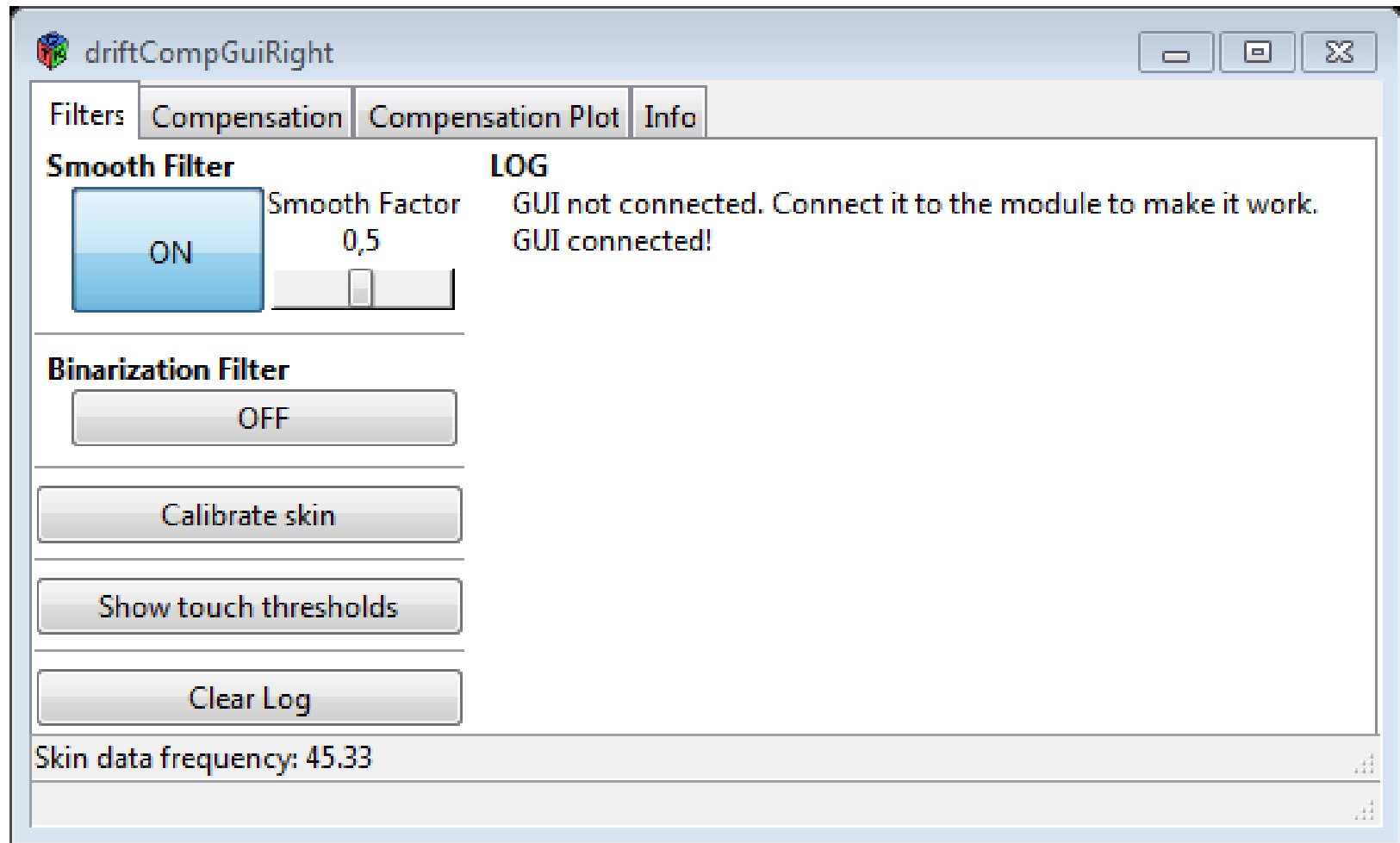
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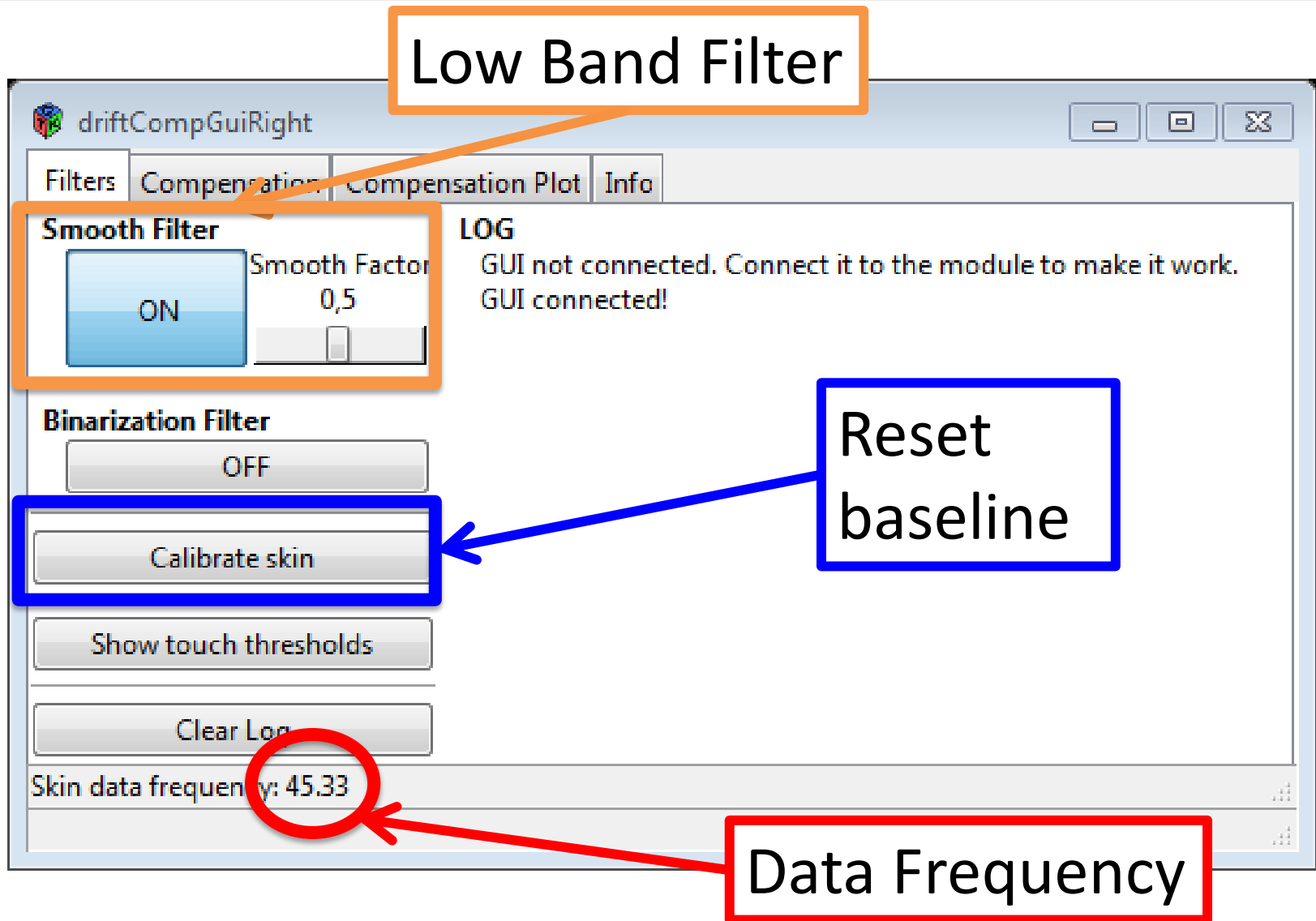
- Each skin taxel output is a double in  $[0, 255]$
- If there is no pressure the output should be 0
- When a pressure is applied the output **increases**

# Touch thresholds

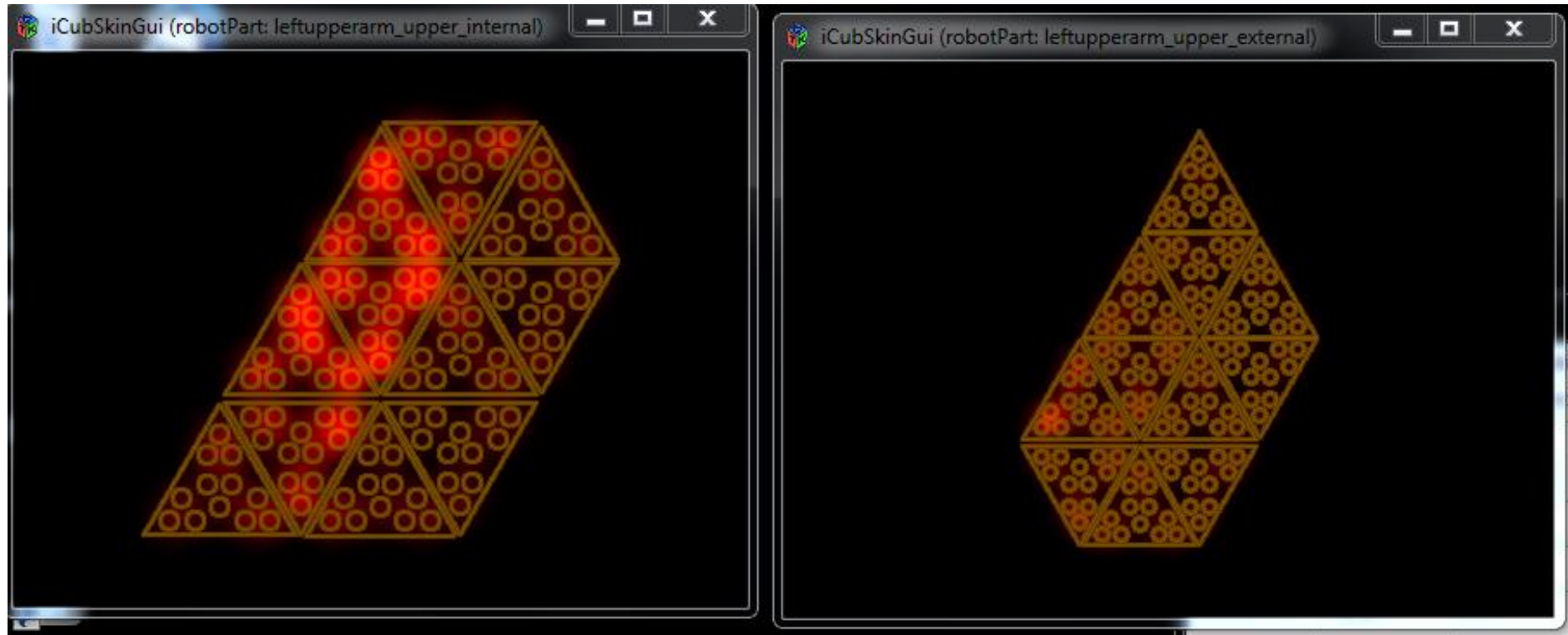
- Each skin taxel is subject to a different noise
- Hence the touch threshold should be different for each taxel
- The SkinDriftCompensation module computes the touch thresholds (the 95% percentile) during its calibration phase
- Touch thresholds may be retrieved sending a message 'get percentile' to the rpc port of the SkinDriftCompensation module

- Located in: `$ICUB_ROOT/main/src/tools`
- A handy alternative to the rpc port of the SkinDriftCompensation module
- Allows the control of the SkinDriftCompensation module
- Shows warning and error messages related to the skin (coming from the SkinDriftCompensation)





# iCubSkinGui



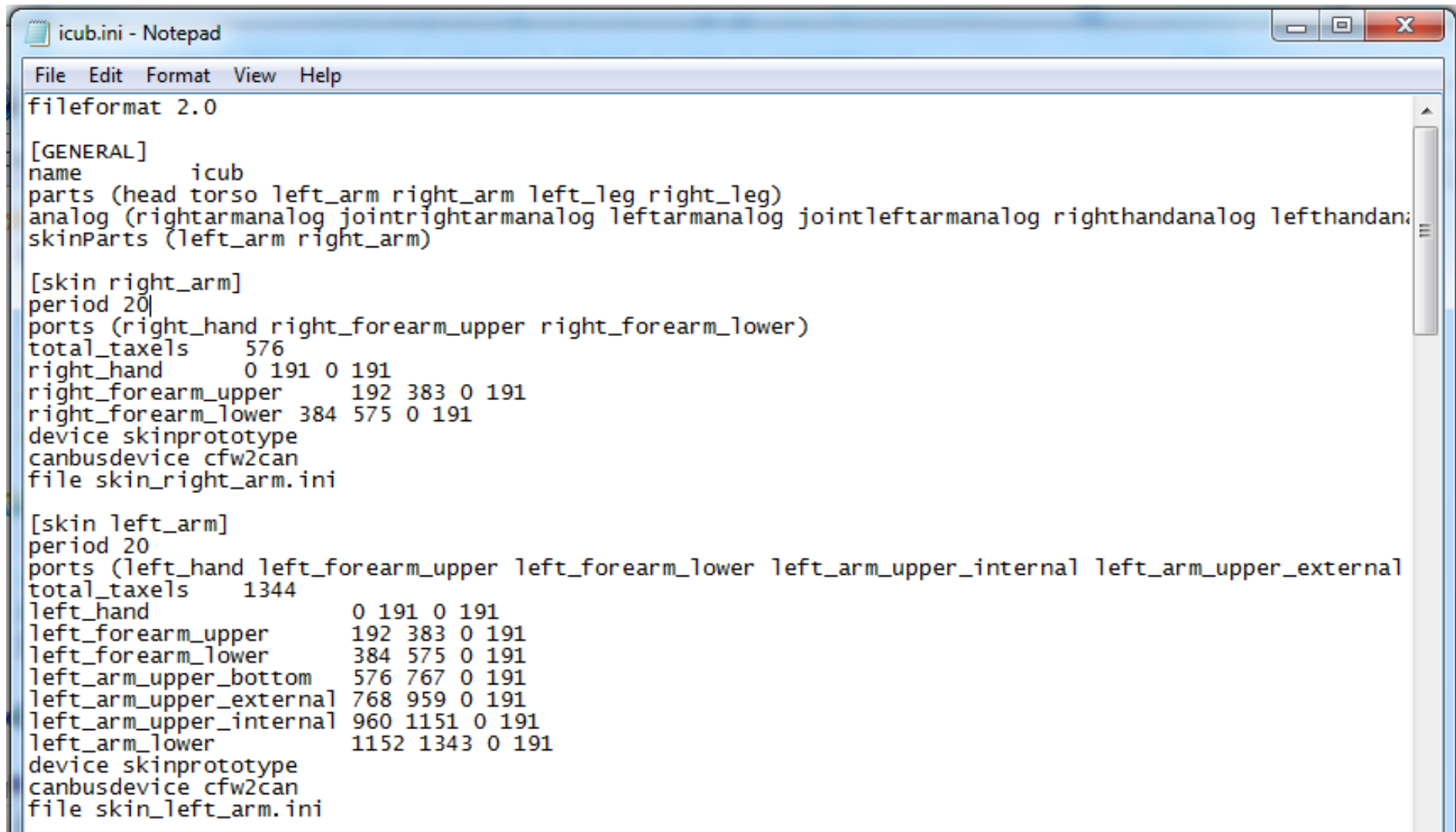


- Located in:  
`$ICUB_ROOT/main/src/tools`
- GUI to display the output of fingertips/skin tactile sensors
- Configuration files located in:  
`$ICUB_ROOT/main/app/iCubSkinDemo`
- If you want to display the compensated skin values run the GUI with the flag  
'useCalibration'

# iCubInterface

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- Runs on the PC104 in iCub's head
- Reads the data from the skin sensors
- Sends the data on yarp ports
- All the skin data in one arm are read as one big vector
- The configuration file 'icub.ini' specifies:
  - how the vector has to be split
  - on which port each part has to be sent

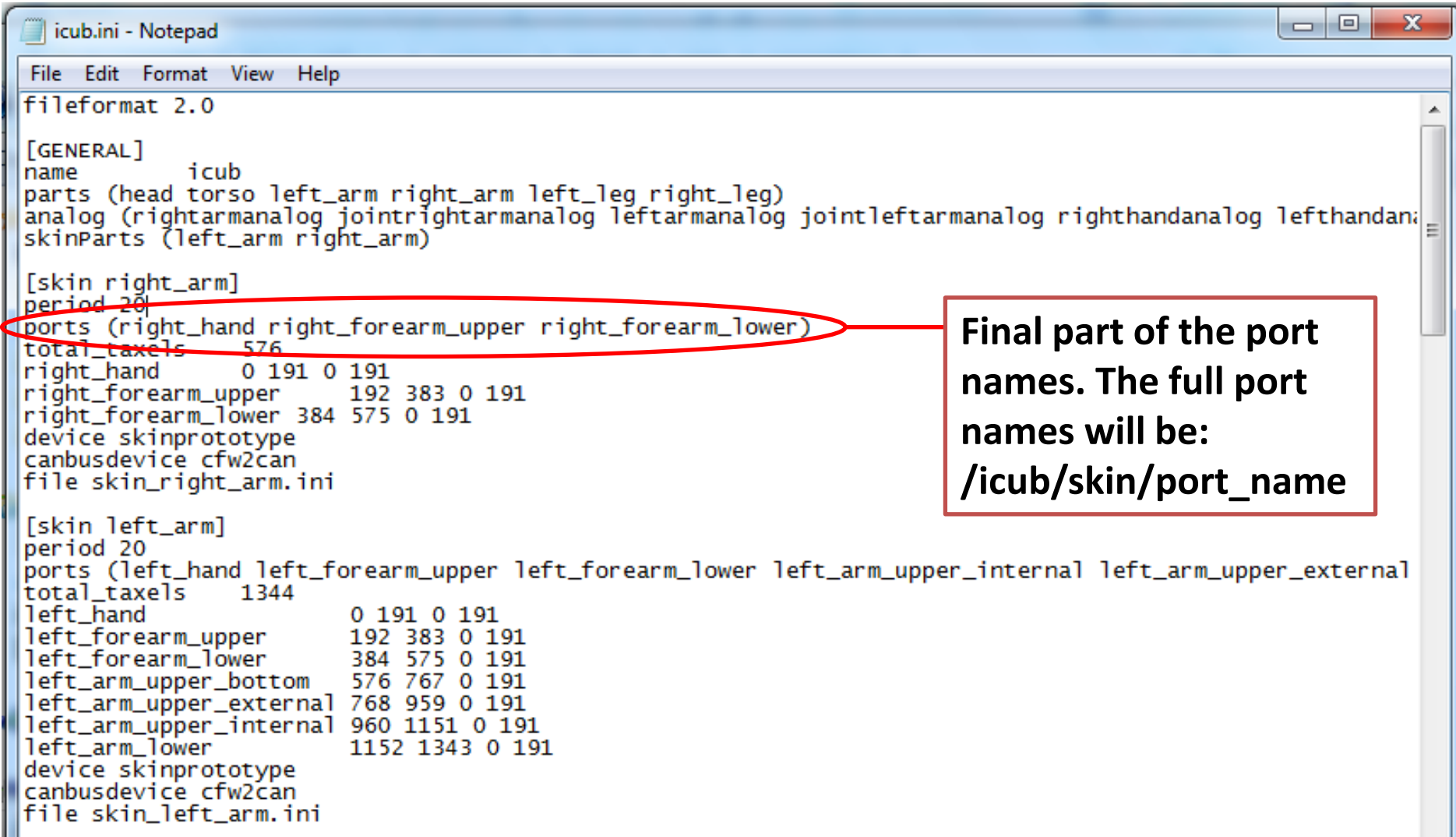


```
icub.ini - Notepad
File Edit Format View Help
fileformat 2.0

[GENERAL]
name icub
parts (head torso left_arm right_arm left_leg right_leg)
analog (rightarmalog jointrightarmalog leftarmalog jointleftarmalog righthandalog lefthandalog)
skinParts (left_arm right_arm)

[skin right_arm]
period 20
ports (right_hand right_forearm_upper right_forearm_lower)
total_taxels 576
right_hand 0 191 0 191
right_forearm_upper 192 383 0 191
right_forearm_lower 384 575 0 191
device skinprototype
canbusdevice cfw2can
file skin_right_arm.ini

[skin left_arm]
period 20
ports (left_hand left_forearm_upper left_forearm_lower left_arm_upper_internal left_arm_upper_external)
total_taxels 1344
left_hand 0 191 0 191
left_forearm_upper 192 383 0 191
left_forearm_lower 384 575 0 191
left_arm_upper_bottom 576 767 0 191
left_arm_upper_external 768 959 0 191
left_arm_upper_internal 960 1151 0 191
left_arm_lower 1152 1343 0 191
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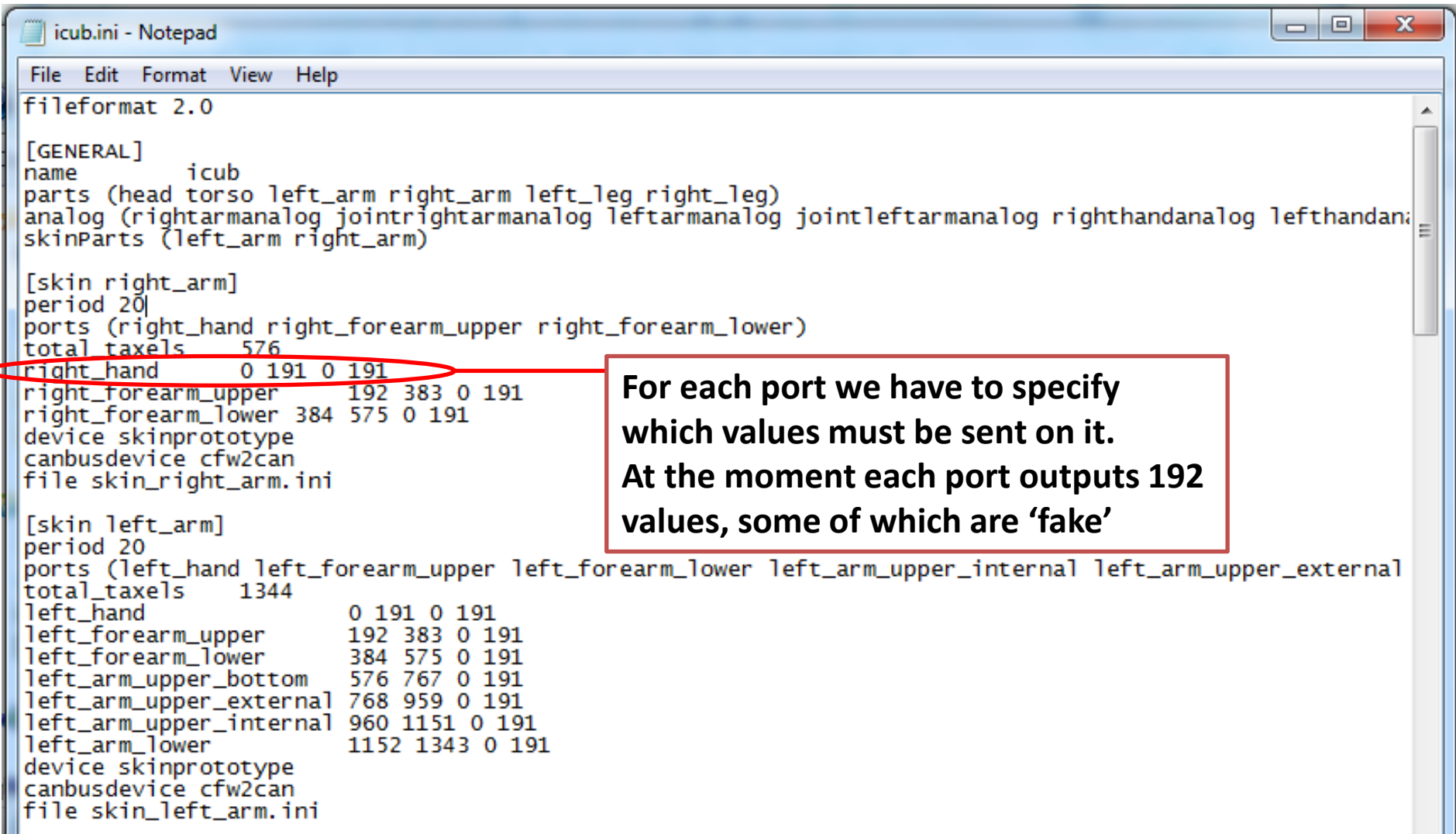
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**Final part of the port names. The full port names will be:**  
**/icub/skin/port\_name**



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File Edit Format View Help
fileformat 2.0

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```

For each port we have to specify which values must be sent on it. At the moment each port outputs 192 values, some of which are 'fake'

- All the scripts and configuration files related to the skin are located in:
  - `$ICUB_ROOT/main/skinGui`
  - `$ICUB_ROOT/main/iCubSkinDemo`
- Let's take a look at this file:
  - `skinGui/scripts/skinGuiRightArm.xml`